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In this paper, I describe the need for education to promote and implement sustainable agriculture in Indonesia, and relate that need to existing educational programs. The current education curricula introduce agricultural sustainability topics as early as junior and senior high school, but the approach is fragmented and topics are not delivered consistently. Although more focused education exists at the university level, it is not well integrated with the various degree programs, and different programs may teach this subject with different content and emphasis. I propose several ways that agricultural education in Indonesia could be improved by consistently incorporating a rigorous, well-defined, standardized course of study in sustainability.

Key words: curricula, education, Indonesia, sustainable agriculture

Introduction

In Indonesia, environmental education is described in Act No. 32/2009 concerning the Protection and Management of the Environment. Section 70, Article (3), of the Act states that communities can play a role through increased attention to protecting and managing the environment, developing the capabilities of Indonesia's people, and pioneering efforts to develop both formal and non-formal forms of environmental education. Environmental education is defined in this context as efforts to change the behaviors and attitudes of individuals by improving their knowledge, skills, and awareness of environmental values, issues, and problems and by motivating them to preserve their environment for both present and future generations. However, the Act does not prescribe education specifically for sustainable agricultural development.

Among the many definitions of sustainable agriculture, the United States 1990 Food, Agriculture, Conservation, and Trade Act (FACTA; Public Law 101−624, Title XVI, Subtitle A, Section 1603) provides an appropriate definition: an integrated system of plant and animal production practices with site-specific application that will, over the long term: satisfy human food and fiber needs; enhance environmental quality and the natural resource base upon which the agricultural economy depends; make the most efficient use of non-renewable resources and on-farm resources and integrate, where appropriate, natural biological cycles and control; sustain the economic viability of farm operation; and enhance the quality of life for farmers and society as a whole. Thus, education for sustainable agriculture must be designed to teach students how to achieve these objectives. In addition, the science of ecology should be used to transform other sciences by serving as an inspiration, a method of elucidating key natural processes, and a philosophy that prescribes new values and norms for modern communities, thereby empowering citizens and perhaps even becoming the basis for a new social movement.

All of these ideas have been touched on in many courses at Indonesia's Bogor Agricultural University (*Institut Pertanian Bogor*) in either undergraduate or graduate programs. The academic curriculum of a program designed to teach sustainable agricultural development (Ag-ESD) should cover issues such as ecology, the impacts of liberalization of global markets, technology, and human resources. The university

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could contribute to this goal by training agricultural scientists and practitioners, providing support for government policy development, and developing technological innovations to improve agriculture. It is important to keep in mind that sustainable development is a transdisciplinary science that brings together expertise from ecology, sociology, political science, and the humanities. This should be emphasized in all sustainability education.

The Tsukuba Asian Seminar on Agricultural Education (http://www.nourin.tsukuba.ac.jp/~tasae/), which is provided under the Asia-Pacific Programme of Educational Innovative Development (APEID, http://www.unescobkk.org/education/apeid/), has been conducting annual seminars with various themes since 1979. The University of Tsukuba's Agricultural and Forestry Research Center, as an Associated Center of APEID, has sponsored an International Symposium on Agricultural Education for Sustainable Development (Ag-ESD) from 2008 to 2013. The aims of Ag-ESD are to help reform and improve agricultural higher education, with the particular goal of considering environmental problems from an international viewpoint.

In this paper, I describe five Indonesian papers presented between 2009 and 2012 in which these issues were discussed, and the role of the Ag-ESD Program at Indonesia's Bogor Agricultural University.

2. Approach

I reviewed five representative Indonesian papers that were presented during the eighth cycle (2008−2013) of the APEID program as well as the academic curricula and research topics of Bogor Agricultural University to evaluate the role and contribution of its Ag-ESD program to sustainable agriculture in Indonesia.

3. Highlights of the presented papers

3.1 First Paper (Murtilaksono and Hidayat, 2009)

The academic curricula for the undergraduate and graduate programs at Bogor Agricultural University are in line with the core scientific pattern that is required by a sustainable agricultural system. Many undergraduate and graduate courses explicitly describe sustainable agriculture, and many others are closely related to ecology because they fully consider that a balanced environment is an important factor in utilizing natural resources or because they include the terms "environment" or "sustainable" in their description.

Sustainable agricultural development and utilization of natural resources have been explicitly addressed in PhD dissertations, MS theses, and BSc final assignment. Because the PhD program is necessarily more comprehensive than MS and undergraduate program, it includes both a theses and a final assignment as undergraduate research report; thus, the subject of sustainable agriculture is also dealt with more quantitatively and in more depth by the PhD program.

Research by the university's staff, as well as extension programs and community services delivered by Bogor Agricultural University, rarely examines sustainable agricultural development comprehensively because the research is more often conducted to comply with the agendas of sponsoring or funding agencies. These agendas often have a narrow focus.

An overall research agenda for Bogor Agricultural University is therefore urgently needed in order to promote a more comprehensive study of sustainable agricultural development, and the Office of Research and Community Services must facilitate the development of this agenda. As of 2013, this agenda was still not well developed yet, then it should be improved to expand opportunities to improve research funding.

3.2 Second Paper (Martianto, 2010)

Indonesia is currently facing food security (nutrition) and safety problems. Although the production of major food commodities has grown, Indonesia still depends greatly on imports for some commodities. More than 25 million Indonesians consume less than 70% of the recommended dietary allowance per person of 2000 kcal/day. The diet of Indonesians is also unbalanced; most of the energy is provided by the consumption of high amounts of rice and wheat, but low consumption of tubers, vegetables, fruits, soybeans, and animal foods. In addition, more than 100 million Indonesian people currently face deficiencies of micronutrients such as iron, vitamin A, and iodine. Most of this population comprises rural farmers with small farm plots, and their agricultural productivity is negatively affected by their poor nutritional status. Food safety of both fresh and processed products is another major issue. For example, textile dyes and other dangerous substances such as formalin are widely used, particularly by small-scale food industries. Solving these problems will require a range of strategic efforts, including improvement of higher education curricula and research in the related fields.

Although it would be useful to implement a food-inspection agency such as those that exist in developed countries, the funding and government infrastructure for such an agency currently do not exist.

Bogor Agricultural University provides a wide range of educational services in fields related to food security and safety. Courses related to food production are taught by the faculties of Agriculture, Animal Husbandry, and Fisheries, and food safety courses are taught by the faculties of Agricultural Technology, Animal Husbandry, and Fisheries. Food security courses are also offered by the Faculty of Human Ecology. Analysis of the contents of these courses indicates that the food safety courses are more suitable for medium to large food industries than for the small-scale operations that have the most serious food safety problems. In addition, many student and faculty research projects have low relevance for current food safety problems and few of them investigate new food alternatives or the improvement of food distribution and accessibility, particularly among the poor. Thus, it's necessary to improve the curricula, course content, research focus, and community services.

3.3 Third paper (Murtilaksono *et al*., 2011)

There is no definition of education for sustainable agricultural development, even though environmental education was defined in Section 70, Article (3), of Act 32/2009 about Environmental Protection and Management.

Currently, environmental education is carried out through monolithic and integrative approaches that incorporate studies of conservation, the environment, and mitigation of natural disasters. Junior and senior high school and higher education about the environment is carried out implicitly in certain courses. The environmental content is indirectly inserted in several courses, although some environmental education may be delivered independently as a local course by some junior and senior high schools.

In junior and senior high school education, there is no explicit environmental education for sustainable agriculture in the curricula, although the Ministry of National Education of the Republic of Indonesia has developed a Vocational Education Development Center for Agriculture. The course content of environmental education is delivered through either curricular or field activities of the schools.

At colleges and universities with agricultural faculties, environmental education is integrated into several supporting competency courses such as plant ecology. The Bogor Agricultural University is an exception because there, the main competence course relates to sustainable agricultural systems, besides environment as one of sustainability principle is delivered in many individual courses.

Many field courses in sustainable agriculture have been conducted by the government, by nongovernmental organizations, or by foreign organizations such as the Environmental Services Program of USAID (http://www.irc.nl/page/30554) and the Strengthening Community-based Forest and Watershed Management program of UNDP (http://www.scbfwm.org/) to focus specifically on agricultural problems (e.g., field courses in integrated pest management, soil and water conservation, watershed management).

3.4 Fourth Paper (Buchori and Ardhian, 2011)

The agricultural landscape of the 21st century has changed throughout the world. It is being transformed by the globalization of markets and the availability of new technologies. New developments in biotechnology, combined with global issues such as climate change and international trade and agricultural regulations, have moved agriculture to the forefront of global concerns about the economy and environmental safety. The ongoing debates over the relationship between agriculture and the environment have only strengthened in this context. Indonesia, with a traditionally agricultural society, must equip itself to face these challenges. Globalization, climate change, and international treaties have placed tremendous pressure on Indonesia to respond. As such, agricultural education also faces strong pressures to adapt to the new context and modify its approach.

Indonesia prides itself as one of the world's most biodiverse nations, but faces the challenge of conserving its rich biodiversity while still allowing socioeconomic development. The question is how this can be achieved. Sustainability has never before been perceived as a key concept as urgently as it is now. Thus, an educational system that teaches sustainability is more important than ever, as it can create a stronger society capable of producing innovation to face the challenge of balancing growth with the needs of the environment. In particular, agricultural sustainability must become a core value in university curricula.

Where is Indonesia now in terms of its curriculum

on sustainability? How does Indonesia define sustainability and incorporate this subject in its educational agenda? Currently, there is growing interest in the relationships between globalization, changes in the rural landscape, and sustainability. Landscape sustainability and the implications of global policy agendas and their intersections with markets and trade should become part of the educational agenda. Landscape ecology offers a particularly powerful synthetic approach to sustainability, and its emphasis upon spatial relationships provides an ideal framework for considering changes in the agricultural landscape. It is important to enhance our understanding of the ways in which contemporary agricultural landscapes are changing in response to emerging market conditions, technological development, and the changing sociocultural and environmental conditions for farming. These issues are the basis for understanding future changes. Integrating landscape-scale ecological research with changes in the agricultural landscape systems will combine landscape-scale planning and agroenvironmental policy analysis to deal with emerging issues. This approach must become a special focus for Indonesian scientists and policy makers.

3.5 Fifth Paper (Hidayat, 2012)

The agricultural sector is a key to Indonesia's economy, as it directly contributes 15% of the national GDP (World Bank, 2013). However, current food production levels cannot meet the food security needs of the country's 238 million people, despite efforts to intensify and develop Indonesia's agricultural sector. Therefore, Indonesia still imports large quantities of food commodities such as corn, soybeans, wheat, and sometimes even rice. Despite these imports, millions of people who live in rural and semi-rural areas have inadequate nutrition.

The challenges facing sustainable agricultural development include a high rate of land conversion to infrastructure, bad agricultural practices, climate change, and outbreaks of plant pests. Walhi Bengkulu (2010) estimated that more than 1 million ha of agricultural land has been converted to non-agricultural uses in the last decade alone, with a potential loss of millions tonnes of food production. Improper agricultural practices contribute to low agricultural yields and degradation of the agricultural environment. Climate change has also adversely affected crop yields, and this has been exacerbated by outbreaks of several plant pests and diseases.

Colleges and universities that offer agricultural education play important roles in promoting sustainable agricultural development in Indonesia. There are hundreds of agriculture faculties throughout Indonesia, including the Bogor Agricultural University. Besides producing highly competent agricultural scientists and practitioners, these colleges and universities are also conducting excellent research in plant breeding, agronomy, plant protection, and agribusiness. They have also contributed to the implementation of the Ministry of Agriculture's programs to improve the professionalism of agriculturist, the skills of farmers, and the roles of agricultural institutions; optimizing the utilization of agricultural resources in a sustainable manner; strengthening food security and safety; increasing the competitiveness of agricultural products and value-added processing; promoting agricultural activities that will improve growth of the rural economy; and improving the management of agricultural policies.

4. Improvements Required for Agricultural Education in Indonesia

4.1 Research

Research by graduate students and university staff rarely examines sustainable agricultural development comprehensively because it is designed more to meet the specific agendas of donors or funding agencies. Thus, an overall research agenda for Bogor Agricultural University must be developed to encourage more comprehensive research on sustainable agricultural development. This should be developed by the Office of Research and Community Services. Because of the narrow focus of sponsoring or funding agencies, it is difficult to develop comprehensive research on sustainability. A challenge for the future will be to educate these agencies about the need for the multidisciplinary approach required by sustainability research.

4.2 Curricula

Environmental education, and particularly its relationship to sustainable agriculture, should be explicitly promoted through various curricular or extracurricular activities, possibly coordinated by the Vocational Education Development Center for Agriculture. The teaching should incorporate key conservation and environmental principles, including the mitigation of natural disasters. This can be formally implemented as specific courses because the current incorporation of

this raining in a fragmentary, non-standardized way witin courses on other subjects is ineffective. Many field courses have been offered in sustainable agriculture to specifically deal with agricultural and environmental problems, but these courses are not a permanent part of the curriculum. These courses should become permanent.

As the leading agricultural university in Indonesia, Bogor Agricultural University has developed sophisticated curricula and promoted research projects that attempt to solve the nation's current food security and safety problems. However, improvement in both the curricula and the research are still needed to develop the knowledge and technology that will support efforts to improve food security and safety based on improving local capacity through sustainable agricultural development (Martianto, 2010).

In Indonesia, environmental education at universities that have agricultural faculties or that offer courses in the agricultural sciences are generally integrated within several supporting competency courses (e.g., plant ecology). Bogor Agricultural University is an exception, since the university offers specific primary courses about agriculture and the environment. Among the hundreds of courses that relate to sustainable agricultural development, the following undergraduate courses are particularly relevant and could be elaborated in the respective department: Soil Conservation; Agricultural Ecology; Integrated Agriculture; Management of the Landscape; Integrated Animal Husbandry; Community Forestry; Resource Economics; and Ecology of Food and Nutrition (Bogor Agricultural University, 2012). While the following graduate courses are particularly relevant and to be detailed that could be taken by any graduate student: Land-use Planning; Advanced Soil and Water Conservation; Global Environmental Policy; System of Sustainable Agriculture; Sustainable Landscape Management; Rural and Agricultural Landscapes; Technology of Environmentally Friendly Fish Catching; Modeling of Fish Catching Areas and Their Environment; Assessment of Forest Ecosystems; Renewable Materials for Sustainable Construction; Planning and Development of Rural Areas; Agricultural Development and Planning; Environmental and Natural Resource Economics; Management of Land Resources (Graduate School, 2012).

At the Ag-ESD symposia, participants had an opportunity to develop and modify, discuss the issues, and learn about efforts to solve problems related to sustainable agricultural development in other countries. In other words, the symposium plays an important role in improving and promoting education for sustainable agricultural development at Bogor Agricultural University, particularly in terms of improving its curricula. Field trips during the symposia provide useful lessons for participants from different countries. Unfortunately, the Indonesian papers presented during the 8th term of the Ag-ESD symposium covered only a narrow range of topics due to limited time and human resources. Encouragement and support are needed to stimulate students and professors to conduct relevant research and to provide community extension services to promote sustainable agricultural development.

Buchori and Ardhian (2011) stated that developing a curriculum is about more than teaching knowledge, attitudes, and skills. It must also help students learn to solve problems. It should allow students to build personal experience; develop the ability to anticipate the consequences of actions from local, national, and global perspectives; develop the ability to redefine their personal and national character; and gain wisdom and develop a meaningful life. Institutions that provide higher education in agriculture play important roles in promoting sustainable development through:

- Becoming involved in and influencing the direction of government agricultural policies
- Promoting education and training in sustainable agriculture
- Developing and inventing technologies to promote sustainable agricultural development

5. Conclusions

Education in sustainable development is the key to creating a strong research and development community that is capable of coping with the challenges and problems related to balancing the needs for socio-economic growth and environmental sustainability. Education that focuses on sustainable agriculture, with sustainable development science at the core of its curricula, should be developed. To accomplish this, Bogor Agricultural University's curricula, course content, research program, and delivery of community services must be improved; this is particularly important because it is the foremost agricultural university in Indonesia, and both trains the most students and provides an example for other universities to follow. Improving the Ag-ESD program will generate

increasingly competent agricultural scientists and practitioners capable of optimizing and sustainably using Indonesia's agricultural resources, thereby improving the nation's food security and safety and protecting the environment that sustains Indonesia's agricultural sector and citizens.

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